of the other. The greatest force would be a little way out, and that, according to Faraday's observations, systematized and expressed in the form of mathematical law by Sir William Thomson, was where the ball would go.

The next discovery of Faraday to which the lecturer called attention was one of immense significance from a scientific point of view, the consequences of which were not even yet fully understood or developed. He referred to the magnetization of a ray of light, or what was called in more usual parlance the rotation of the plane of polarization under the action of magnetic force. It would be hopeless to attempt to explain all the preliminaries of the experiment to those who had not given some attention to those subjects before, and he could only attempt it in general terms. It would be known to most of them that the vibrations which constituted light were executed in a direction perpendicular to that of the ray of light. By experiment he showed that the polarization which was suitable to pass the first obstacle was not suitable to pass the second, but if by means of any mechanism they were able, after the light had passed the first obstacle, to turn round the vibration, they would then give it an opportunity of passing the second obstacle. That was what was involved in Faraday's discovery. As he had said, the full significance of the experiment was not yet realized. A large step towards realizing it, however, was contained in the observation of Sir William Thomson, that the rotation of the plane of polarization proved that something in the nature of rotation must be going on within the medium when subjected to the magnetizing force, but the precise nature of the rotation was a matter for further speculation, and perhaps might not be known for some time to come.

When first considering what to bring before them, the speaker thought, perhaps, he might include some of Faraday's acoustical experiments, which were of great interest, though they did not attract so much attention as his fundamental electrical discoveries. He would only allude to one point which, as far as he knew, had never been noticed, but which Faraday recorded in his acoustical papers. "If during a strong steady wind, a smooth flat sandy shore, with enough water on it, either from the receding tide or from the shingle above, to cover it thoroughly, but not to form waves, be observed in a place where the wind is not broken by pits or stones, stationary undulations will be seen over the whole of the wet surface. . . . These are not waves of the ordinary kind; they are (and this is the remarkable point) accurately parallel to the course of the wind." When he first read that statement, many years ago, he was a little doubtful as to whether to accept the apparent meaning of Faraday's words. He knew of no suggestion of an explanation of the possibility of waves of that kind being generated under the action of the wind, and it was, therefore, with some curiosity that two or three years ago, at a French watering-place, he went out at low tide, on a suitable day when there was a good breeze blowing, to see if he could observe anything of the waves described by Faraday. For some time he failed absolutely to observe the phenomenon, but after a while he was perfectly well able to recognize it. He mentioned that as an example of Faraday's extraordinary powers of observation, and even now he doubted whether anybody but himself and Faraday had ever seen that phenomenon.

Many matters of minor theoretic interest were dealt with by Faraday, and reprinted by him in his collected works. The speaker was reminded of one the other day by a lamentable accident which occurred owing to the breaking of a paraffin lamp. Faraday called attention to the fact, though he did not suppose he was the first to notice it, that, by a preliminary preparation of the lungs by a number of deep inspirations and expirations, it was possible so to aërate the blood as to allow of holding the breath for a much longer period than without such a preparation would be possible. He remembered some years ago trying the experiment, and running up from the drawing-room to the nursery of a large house without drawing any breath. That was obviously of great practical importance, as Faraday pointed out, in the case of danger from suffocation by fire, and he thought that possibly the accident to which he alluded might have been spared had the knowledge of the fact to which Faraday drew attention been more generally diffused.

The question had often been discussed as to what would have been the effect upon Faraday's career of discovery had he been subjected in early life to mathematical training. The first thing that occurred to him about that, after reading Faraday's works, was that one would not wish him to be anything different from what he was. If the question must be discussed, he supposed they would have to admit that he would have been saved much wasted labor, and would have been better *en rapport* with his scientific contemporaries if he had had elementary mathematical instruction. But mathematical training and mathematical capacity were two different things, and it did not at all follow that Faraday had not a mathematical mind. Indeed, some of the highest authorities (and there could be no higher authority on the subject than Maxwell) had held that his mind was essentially mathematical in its qualities, although they must admit it was not developed in a mathematical direction. With these words of Maxwell he would conclude: "The way in which Faraday made use of his idea of lines of force in co-ordinating the phenomena of electric induction shows him to have been a mathematician of high order, and one from whom the mathematicians of the future may derive valuable and fertile methods."

## THE "SUBMARINE SENTRY.

AT a recent meeting of the Royal United Service Institution, London, a lecture upon sounding machines was given by Professor Lambert of the Royal Naval College, Greenwich. In the course of the lecture (some details of which appear in *Engineering* of June 26) a description was given of an instrument called a "submarine sentry," which has been successfully experimented with on some ships of the British navy. It is the invention of Mr. Samuel James, a civil engineer.

As described by the lecturer, the sentry is intended to give a continuous under-water look-out, and to automatically give warning of the approach of shallow water. It consists of an inverted wooden kite, which can be trailed at the stern of a vessel at any required depth to forty-five fathoms. On striking bottom, the blow, acting on a projecting trigger, releases the slings of the kite and causes it to rise to the surface and trail in the wake of the vessel. At the instant of striking, the sudden loss of tension in the wire sounds a gong attached to a winch on board the ship. The wire used is of steel, and of the highest tenacity attainable. Its diameter is 0.067 of an inch, and it is capable of bearing a stress of fully a thousand pounds. During towing the vibration of the wire causes a continuous rattle in a sounding box, and the cessation of this noise gives an additional indication when the sentry has struck the bottom. The vertical depth of the kite at any time is indicated on the dial plate of the winch. The curve formed by the wire while towing is concave downwards, and at first sight it would appear as if this curve would change its form, and the sinker trail further astern and at less depth when the ship's speed was increased. Professor Lambert had carefully plotted out this curve, and showed the results on a diagram. By a mathematical analysis he showed that the instrument would remain constant in its record at any speed of the ship between five and fifteen knots. The weight of the kite is equal to, and is therefore neutralized by, its own buoyancy, and the weight of the wire is negligible compared to the forces due to the motion through the water.

The forces which remain to be considered are, (1) the fluid pressure on the kite, (2) the fluid pressure on the under side of the wire, and (3) the tension of the wire. The latter is the result of the two former. Pressures due to fluid motion vary nearly as the square of the velocity. If, therefore, the velocity of the ship be doubled, forces (1) and (2) will each be multiplied by four, the three forces will all be changed proportionally, and there will be no change in the direction in which they act. This is only put forward as a rough explanation of the phenomena, but that it is practically true has been, it is claimed, corroborated by practical tests, — the depth of the sinker not varying more than half a fathom in thirty at speeds of from five to thirteen knots, above which speed the instrument is not designed to be used.

There are two descriptions of kite, one set at an angle to give

soundings down to thirty fathoms, and the other slung so as to register down to forty-five fathoms. With the former about four and a half horse-power is absorbed at a speed of eight knots. It should be stated that the apparatus can be used for taking soundings at any depth within its limits of working, as well as to form a permanent indication of when the ship passed into water of less than a given depth. All that is required to do is to pay the kite out slowly, with a hand on the brake which is provided for checking the speed. When the gong sounds, a glance at the dial will show the vertical depth due to the length of wire paid out.

## EXPERIMENTS WITH LEYDEN JARS.

AT a meeting of the Physical Society, London, held June 12 (reported in *Engineering* of June 19), some experiments with Leyden jars were shown by Dr. Lodge. The first one was with resonant jars, in which the discharge of one jar precipitated the overflow of another when the lengths of the jar circuits were properly adjusted or tuned. The latter jar was entirely disconnected from the former, and was influenced merely by electromagnetic waves emanating from the discharging circuit. Lengthening or shortening either circuit prevented the overflow. Correct tuning was, he said, of great importance in these experiments, for a dozen or more oscillations occurred before the discharge ceased. The effect could be shown over considerable distances. In connection with this subject Mr. Blakesley had called his attention to an observation made by Priestley many years ago, who noticed that when several jars were being charged from the same prime conductor, if one of them discharged, the others would sometimes also discharge, although they were not fully charged. This he, Dr. Lodge, thought might be due to the same kind of influence which he had just shown to exist. The word "resonance," he said, was often misunderstood by supposing it always had reference to sound, and as substitutes he thought that "symphoning" or "symphonic" might be allowable.

The next experiment was to show that wires might be tuned to respond to the oscillation of a jar-discharge, just as a string could be tuned to respond to a tuning-fork. A thin stretched wire was connected to the knob of a jar, and another parallel one to its outer coating, and, by varying the length of an independent discharging circuit, a glow was caused to appear along the remote halves of the stretched wires at each discharge. Each of the wires thus acted like a stopped organ pipe, the remote ends being the notes at which the variations of pressure are greatest. By using long wires he had observed a glow on portions of them with the intermediate parts dark: this corresponded with the first harmonic, and by measuring the distance between two nodes, he had determined the wave length of the oscillations. The length so found did not agree very closely with the calculated length, and the discrepancy he thought due to the specific inductive capacity of the glass not being the same for such rapidly alternating pressures as for steady ones. He also showed that the electric pulses passing along a wire could be caused (by tuning) to react on the jar to which it was connected, and cause it to overflow, even when the distance from the outside to the inside coating was about eight inches. During this experiment he pointed out that the noise of the spark was greatly reduced by increasing the length of the discharging circuit. The same fact was also illustrated by causing two jars to discharge into each other, spark gaps being put both between their inner and outer coatings, so as to obtain "A" sparks and "B" sparks. By putting on a long "alternative path" as a shunt to the B spark gap, and increasing that gap, the noise of the A spark was greatly reduced. He had reason to believe that the B spark was a quarter phase behind the A spark, but the experimental proof had not been completed.

He next described some experiments on the screening of electromagnetic radiation, in which a Hertz resonator was surrounded by different materials. He had found no trace of opacity in insulators, but the thinnest film of metal procurable completely screened the resonator. Cardboard rubbed with plumbago also acted like a nearly perfect screen. In connection with resonators he exhibited what he called a graduated electric eye, or an electric harp, made by his assistant, Mr. Robinson, in which strips of tinfoil of different lengths are attached to a glass plate, and have spark gaps at each end which separate them from other pieces of foil. One or other of the strips would respond according to the frequency of the electro-magnetic radiation falling upon it.

## A GIFT TO THE UNIVERSITY OF CHICAGO.

THE executors of the estate of the late William B. Ogden, who was the first mayor of Chicago, have selected the University of Chicago as one of the beneficiaries under the terms of Mr. Ogden's will, — giving it a scientific school.

The conditions attached by the executors to the gift — which will amount to from three hundred thousand to half a million dollars — are, that the school shall be a separate department of the university, and bear the name of the Ogden Scientific School, its purpose being to furnish graduate students with the best facilities possible for scientific investigation by courses of lectures and laboratory practice. The income of the money appropriated is to be devoted to and used for the payment of salaries and fellowships, and the maintenance of laboratories in physics, chemistry, biology, geology, and astronomy, with the subdivisions of these departments. A large share of the time of the professors in the school is to be given to original investigation, and encouragement of various kinds is to be furnished them to publish the results of their investigations, a portion of the funds being set apart for the purpose of such publication. The school is to include all the graduate work of the university on the subjects mentioned, and further appropriations or donations which may be made toward these objects are to be added to the original foundation, and not to be devoted to new schools doing similar or parallel work. Some portion of the income of the foundation is to be set apart for the purchase of books to be placed in the special departmental and laboratory libraries of the proposed school.

The university in accepting this gift is required to pledge itself to erect the contemplated school, under the suggested name, on the receipt of $300,000, whether or not the wish and expectations of the trustees be realized in the final receipt from the fund of a much larger sum. In the event, however, of any unforeseen circumstances preventing the money designated from reaching the sum of $300,000, the money which may be received shall be used for the endowing of one or more professorships in the university to be severally known as the Ogden Professorships.

It is further desired that at least one of the board of trustees of the university shall be the nominee of the executors and trustees of Mr. Ogden's estate, in order that in the formation and development of the scientific school proposed, the wishes of the trustees may be voiced by at least one member of the governing board of the university. And finally it is required that it shall be distinctly understood that there shall be absolute freedom in respect to the admission to the proposed school of students and professors alike, without reference to their particular religious beliefs.

## LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

*On request, twenty copies of the number containing his communication will be furnished free to any correspondent.*

*The editor will be glad to publish any queries consonant with the character of the journal.*

### The Dissipation of Energy.

IN passing through a grove of scattered timber after a recent thunder-storm, I came to a tree that had been struck by lightning, a honey-locust (*Gelditschia*), about two feet in diameter.

At the bifurcation of the topmost limbs the bark and sap-wood were torn off for two or three inches in width, increasing as it passed down, until within ten feet of the ground, where it seemed to pass in and explode from the centre, splintering the tree on one side for a foot or two, then tearing the bark and sap-wood for a little ways down, and then leaving the rest without a mark on it for two or three feet above the roots. The splinters were scattered in a half circle twenty feet from the tree. The tree appeared to be perfectly sound and free from defect.